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Construction of a surrogate model for crash box corruption

Kakeru SUGIYAMA[1*] and Yoshitaka WADA[2]

[1] Kindai University, Higashi-Osaka, Osaka, Japan, 2133330355e@kindai.ac.jp
[2] Kindai University, Higashi-Osaka, Osaka, Japan, wada@mech.kindai.ac.jp

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In the manufacturing industry, it is important to produce better products within a certain period for shortening of product lifecycles. Since a large number of computational simulation cases are required in the initial study stage of development. In order to shorten evaluation period, machine learning technologies and 1D-CAE becomes popular in addition to conventional CAE evaluation[1].

The use of predictive models based on deep learning as a substitute for CAE is one of the evaluation methods. While we have much expectations for high accuracy, the applications to engineering problems are not enough to satisfy the expecations[2]. In the fields of material design and computational fluid dynamics, good results have been reported, because huge amounts of data are eventually generated in those research fields[3]. Therefore, the objective of this study is a construction of framework using machine learning technology to evaluate crash box corruption for a significant reduction of CAE analysis cost.

The structural strength evaluation of crash boxes is predicted by machine learning in this study. The training data was obtained from the dynamic elastic plastic analysis of the crash box. The input physical quantities are barrier angle, box thickness, material properties and mass equivalent to vehicle weight. The output physical quantity is the reaction force. F-S diagram is predicted by deep learning using convolutional neural networks with data augmentation for regression problem. Buckling is occurring in the analysis and different directions of curruptions are one of the most interesting phenomenon from a point of engineering view.

We have several difficulties to construct the surrogate model, because of imbalanced frequency problem and The time series of the reaction force maxima is different depending on the data. W'd like to propose an adaptive method for machine learning in structural evaluation that can be used for a wide range of structural evaluations.

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